agricultural research

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Home Grown

America is bullish on family vegetable gardens. In recent years seedsmen have consistently sold more seeds of vegetables than of flowers. Now comes additional evidence of this burgeoning interest. A national public opinion polling organization reports that one of every two U.S. households plants a vegetable garden. Moreover, the poll indicates that millions of other Americans would plant them if they could find available plots of land.

Not unexpectedly, those polled gave two main reasons for vegetable gardening: to save on the weekly food bill and to enjoy right-out-of-the-garden freshness and flavor. Unfortunately, the poll also disclosed a high rate of dropouts among beginning gardeners. Experts say that beginners often attempt too large a garden, lack a good garden plan, and fail to practice basic skills. Perhaps beginners need to realize that successful gardening calls for a commitment to time and to acquiring knowledge of elementary gardening lore.

It is an easy and pleasant road to such a commitment. First, experts suggest that the beginner hold next spring's garden size to no larger than 15 by 25 feet—an area, that given a little proper daily tending, will yield surprisingly rich and varied harvests. Second, now that winter has set in, he should invest some fireside time to studying some of the lore so generously shared by the vast fraternity of gardeners. For the price of a few postcards, he can obtain a wealth of garden information in the catalogs of seedsmen and nurserymen. Their pages brim with descriptions and photos of plants, their planting and harvesting dates and growing requirements. By following the typical catalog's instructions, the beginner can sketch a garden plan encompassing the varieties he wants with the amounts of each needed. There are other sources of information: garden centers, local gardeners and clubs, county agents, State and Federal publications. Gardeners also enjoy the constant support of ARS scientists and their colleagues in government and industry who provide improved varieties, cultural practices, and disease and plant control methods.

Many new gardeners will discover the Green Kingdom with the onset of the growing year. Soon they will learn that gardening does more than save money and provide flavorful vegetables. For gardening also sustains the human spirit and teaches vital lessons about living in peace with the earth. They will enjoy the roll of the reasons, and endings that flow to beginnings, seeds and the springtime of planting them.

COVER: Cucumbers pour from the conveyor belt of a mechanical harvester as Michigan's pickle season gets into full swing. Cucumbers, once considered an "endangered" crop because of the unavailability of hand labor, are making a comeback with the advent of mechanical harvesters. The harvester, adapted to a standard tractor, can harvest more than 200 bushels of cucumbers per hour (0874X1423–20). Article begins on page 7.

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Earl L. Butz, Secretary
U.S. Department of Agriculture

Talcott W. Edminster, Administrator
Agricultural Research Service

Above: A calf's tear-stained cheek attracts a ubiquitous fly. Flies are capable of carrying pinkeye by surface transmission for 24 hours, and, as indicated by the fly's presence in the photograph, are quite persistent (0874X1242–1).
***Left:** Working in a cattle chute, John Weimers, an Iowa State University veterinary student, collects eye swab specimens for laboratory examination. The presence of eye lesions is also noted and recorded (0874X1240–7).*

Searching for a Pinkeye solution

Losses from pinkeye in cattle would be insignificant if young calves could be given the same protection that adult cattle develop after contracting the disease.

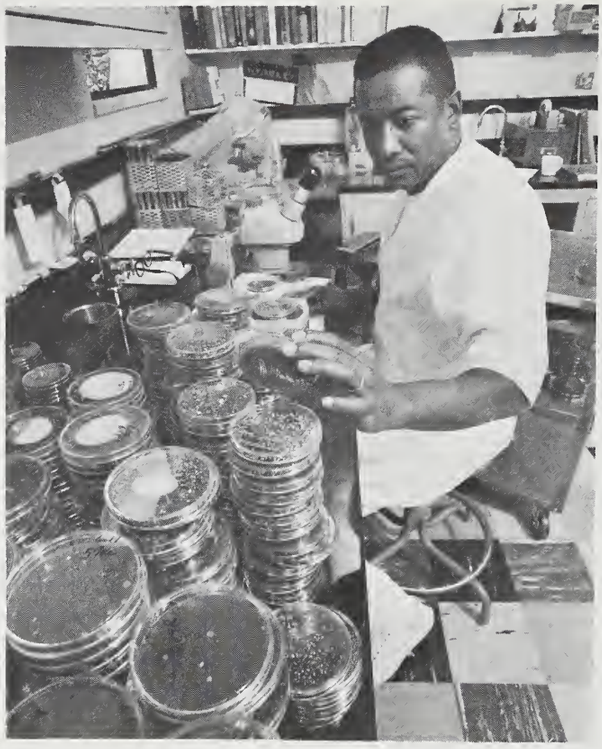
Studies at the National Animal Disease Center, Ames, Iowa, suggest that vaccination might provide that level of protection. ARS veterinary medical officers David E. Hughes and George W. Pugh, Jr., have developed an experimental vaccine that appears promising when used on calves confined indoors. Effectiveness of the vaccine under field conditions is still to be determined.

Pinkeye of cattle, known scientifically as infectious bovine keratoconjunctivitis, slows growth of calves and weight gain of feeders, reduces milk production, and often causes temporary or permanent blindness. The disease was first described in the 1880's and occurs in all cattle-raising areas.

Dr. Hughes and Dr. Pugh began systematic study of the disease in 1963. They worked extensively with a bacterium, *Moraxella bovis,* isolated from animals with pinkeye and which most investigators consider to be the causative agent (AGR. RES., Sept. 1965, p. 13). They were able to infect the eyes of calves more readily, and more eyes developed disease, in the laboratory when animals were placed under sunlamps a short time daily in the first 5 weeks after exposure to *M. bovis.* Use of sunlamps simulated the intense sunshine during hot, dry periods in summer when the disease occurs.

The possibility that vaccination could be used to provide a useful degree of protection against pinkeye was suggested in a subsequent 5-year field study. The researchers found less infection and disease among cows than among their calves. Other investigators had also indicated that cattle are resistant to re-exposure to pinkeye.

In the study, the researchers isolated *M. bovis* from 75 percent of the calves and 63 percent of the cows in an untreated beef cattle herd. Pinkeye developed in 58 percent of the calves not



Right: *Dr. Pugh examines a stack of culture plates for* Moraxella bovis, *which ARS researchers consider to cause pinkeye (0874X1239–29).* ***Below:*** *Mr. Wiemers holds a calf while ARS veterinarian David E. Hughs injects an experimental vaccine of non-viable* M. bovis *culture (0874X1241–7).*

previously exposed to the disease. But the disease developed in only 16 percent of the cows, which had been through two, three, or more pinkeye seasons.

Dr. Hughes and Dr. Pugh then prepared an experimental vaccine, a viable *M. bovis* culture administered intramuscularly. Results of its use under laboratory conditions demonstrated the potential value of vaccination for protection against pinkeye.

When the scientists evaluated the immune status of the cattle by challenge exposure to virulent *M. bovis*, 86 percent of the unvaccinated controls and only 24 percent of the vaccinated animals developed lesions of pinkeye. The level of protection conferred by vaccination thus approximated that in animals that have previously contracted the disease.

The next step was to test the effectiveness of vaccination with a nonviable culture, which would avoid the risk of introducing *M. bovis* into a herd in a viable vaccine. The formalin-killed bacterin then developed by the scientists proved as effective as the viable culture vaccine in subsequent testing in a laboratory situation.

How effective is a bacterin under natural conditions on the farm? Does it give enough protection to be of practical value? Field tests at the U.S. Meat Animal Research Center, Clay Center, Nebr., may answer these questions. The researchers prepared a bacterin from a strain of *M. bovis* isolated from the MARC herd and are testing it in about 60 calves. Development of symptoms and disease in these and about 180 unvaccinated calves will be compared.

If the vaccine provides the desired protection under field conditions, the researchers point out that additional research will be needed before it can be considered for commercial use. Still to be determined are the number of vaccinations required, whether one vaccine will protect against major naturally occurring forms of the disease, and how to deal with the sensitivity of some animals to the vaccine. □

Protein for a hungry world

A recent United Nations report estimates that as many as 1.5 billion people in the developing countries do not receive an adequately balanced diet. Many children in this group receive less protein than required for normal daily activities.

Dietary improvement for these people can come from bread and other bakery goods made from a blend of wheat and soybean flour. Of all export foods, wheat and wheat products are the most abundant and most readily accepted, primarily because they may be used in recipient countries for making conventional native foods.

While wheat flour (11 percent protein) is the essential ingredient in making acceptable baked products, the addition of soy flour (52 percent protein) provides a blend with more protein of better amino acid balance than wheat flour alone. The addition of vitamin A, calcium carbonate, thiamin, riboflavin, niacin, and iron to the blend further enhances its nutritional quality.

Two mixtures of soy and wheat flour are available in the U.S. Government's Food for Peace Program, depending on the recipient nation's protein requirements. One soy-fortified flour, a mixture of 88 parts wheat flour and 12 parts soy flour, contains 16.2 percent protein and yields bread of a light creamy color and slight soybean taste. The second soy-fortified flour, a mixture of 94 parts wheat flour and 6 parts soy flour, contains 14 percent protein and yields bread essentially indistinguishable from that made from white flour.

The white flour is often important to receipients who may feel it represents a higher standard of living. White bread has served as a status symbol since the days of the Egyptian Pharaohs, who required slaves to sift their flour through many silk cloths to get a clean white flour.

In a standard protein rating test, young growing rats gained 0.8 to 0.9 grams of weight on diets containing wheat flour alone as the protein source. The 12 percent soy-fortified flour produced a 1.8 gram weight increase and the 6 percent flour increased weight by 1.3 grams.

Soy-fortified flour makes up about 1/10 of current U.S. flour exports and estimates indicate that in 1975 it will rise to 1/3. Receiving countries are many and include India, the Philippines, and several Central and South American countries.

Each country can make its own native foods from the blends, usually with only slight changes in culinary practices. A new product developed in the Philippines, however, is the nutribun. The bun was developed for the Philippine school nutrition program after studies showed that 34 percent of the school age children were eating substantially fewer calories and less protein than recommended for maintaining good health.

This deficiency is made up by providing a bun containing 500 calories and 17 to 18 grams of protein which represents 1/4 of the daily energy and 1/3 of the prôtein need of the average elementary school child. This year the nutribun is being served to 1.6 million children in 3,000 schools—about 1/4 of the elementary school children in the Philippines.

India provides a similar food for its school children, but with less sugar and more oil to provide more calories.

Soy-fortified flour was originally developed at Kansas State University, Manhattan. A team lead by ARS food technologist David A. Fellers at the Western Regional Center, Berkeley, Calif., developed specifications for the Federal Government's export donation program. The scientists determined what ingredients were needed and proper storage conditions. They also

devised baking tests for quality assurance in the purchasing program.

Dough conditioners are needed in these soy-flour blends to counteract the loaf volume-depressing effect of soy. The ideal dough conditioner is a dry powder, easily mixed with flour, inexpensive, and stable at high temperatures for long storage periods. Current government purchase specifications approve the use of only one conditioner—(sodium stearoyl-2-lactylate)—although others are commercially available.

Research leader Maura Bean, in charge of cereal products at the Center, is now conducting tests to evaluate the effects of other dough conditioners on the finished breads. "We are attempting to find additional dough conditioners that will be just as effective as the one currently being used. This will give millers a chance to pick the one they want to use," said Ms. Bean. "One conditioner studied. an ethoxylated monoglyceride, has shown better functional property retention in the blends, especially under more adverse storage conditions of high temperature and moisture." □

Better Citrus with Bioregulators

ALTHOUGH color, flavor, and nutritive values of citrus are genetically controlled, these qualities may be improved by methods other than through long-term plant breeding.

Regulation of the genes controlling the natural biosynthetic pathways may be a new and exciting concept that can be employed to enhance color, improve flavor, and raise the nutritional level of citrus fruits after harvesting. Better color and nutritive value of existing varieties of oranges, for instance, can be achieved, thereby circumventing the need for a crossbreeding program by plant geneticists to obtain new varieties. The same concept may have application for some vegetables and grains. In grains, it may be possible to stimulate an increase in the protein content.

ARS chemists at the Subtropical Fruit Laboratory, Pasadena, Calif., are spraying bioregulators developed at the lab on harvested citrus fruits to deepen the orange color and increase the provitamin A content. Bioregulators are compounds that regulate certain biosynthetic pathways in the fruit, bringing about a greater accumulation of specific carotenoids, naturally occurring plant pigments, and in most cases a rise in the provitamin A content. Provitamin A is converted in the human liver to vitamin A, and is involved in the body's immunity mechanism and also prevents night blindness.

Genes within the fruit control the color and the provitamin A content. After the fruit reaches maturity, these genes are repressed, thus turning off the biosynthetic pathway. Treating the fruit with bioregulators causes the naturally occurring genetic repression to be lessened and reopens the biosynthetic pathway, causing the desired carotenoids to continue to accumulate.

The citrus industry has expressed a great interest in this work. Raising the nutritional level would allow its product to better compete with artificial fruit drinks high in provitamin A. The deeper orange color of the fresh fruit would also make it much more attractive to the consumer.

Chemists Henry Yokoyama, Wan-Jean Hsu, Stephen M. Poling, Ernest Hayman and Charles DeBenedict at Pasadena have classified the 80 bioregulators found to date into three groups.

The first group stimulates the biosynthesis of lycopene, the carotenoid that makes tomatoes red, and the provitamin A *gamma*-carotene. Because of the large accumulation of lycopene, the Group 1 bioregulators cause the color of the treated fruit to be redder than desirable. The study of this group, however, led the chemists to discover two other groups of bioregulators.

Group 2 bioregulators cause oranges to produce increased amounts of three provitamin A carotenoids, *alpha*-carotene, *beta*-carotene and *gamma*-carotene. Fruit color development proceeds from the untreated color, to a deeper orange color which may last several weeks, and eventually to the red color seen with Group 1.

Group 1 and 2 compounds are potentially useful in improving the color of oranges intended for processing because development can be stopped at the desirable color simply by juicing the fruit. Those Group 2 compounds, which cause the fruit to retain the deep orange color for several weeks may also be useful for improving fruit destined for the fresh fruit market.

Group 3 bioregulators came closest yet to what the chemists are looking for as an aid to the citrus industry and to the homemaker in search of nutritional foods that look good. These compounds are the first found that give a desirable color while causing only insignificant amounts of the red pigment, lycopene, to accumulate. Fruit color development is slow and never goes beyond deep orange. The orange color produced by Group 3 is caused by two as yet unidentified carotenoids.

Bioregulators in these three groups can stimulate and direct carotenoid biosynthesis not only in citrus but also in a wide variety of other higher and lower plant tissues including carrots, sweet potatoes, apricots, peaches, mold mycelia, and cells of photosynthetic bacteria.

The search continues at the lab for even better bioregulators with an eye toward isolating naturally occurring carotenoid inducers from citrus fruits and molds. Since bioregulators are to be used on food, they will have to pass stringent Food and Drug Administration safety standards before they can be applied commercially.

The bioregulatory research at the Pasadena Laboratory is partly funded by the California and Florida citrus industries, and also involves informal cooperation with the California Agricultural Experiment Station, the Florida Department of Citrus, the USDA Date and Citrus Station, Indio, Calif., and the USDA Horticultural Research Laboratory, Orlando, Fla. □

Sweet cherries fall onto the "wings" of a two-sectioned trunk-shaking harvester. The fruit moves up the inclined conveyor to a plastic-lined pallet box that has been partially filled with water to reduce impact and handling damage and which also facilitates volume buying. The harvester's two halves move independently and close at each tree. The harvester can remove the fruit from a tree in just 15 seconds and can handle 60 trees per hour (0874X1387–12).

Mechanizing the harvest

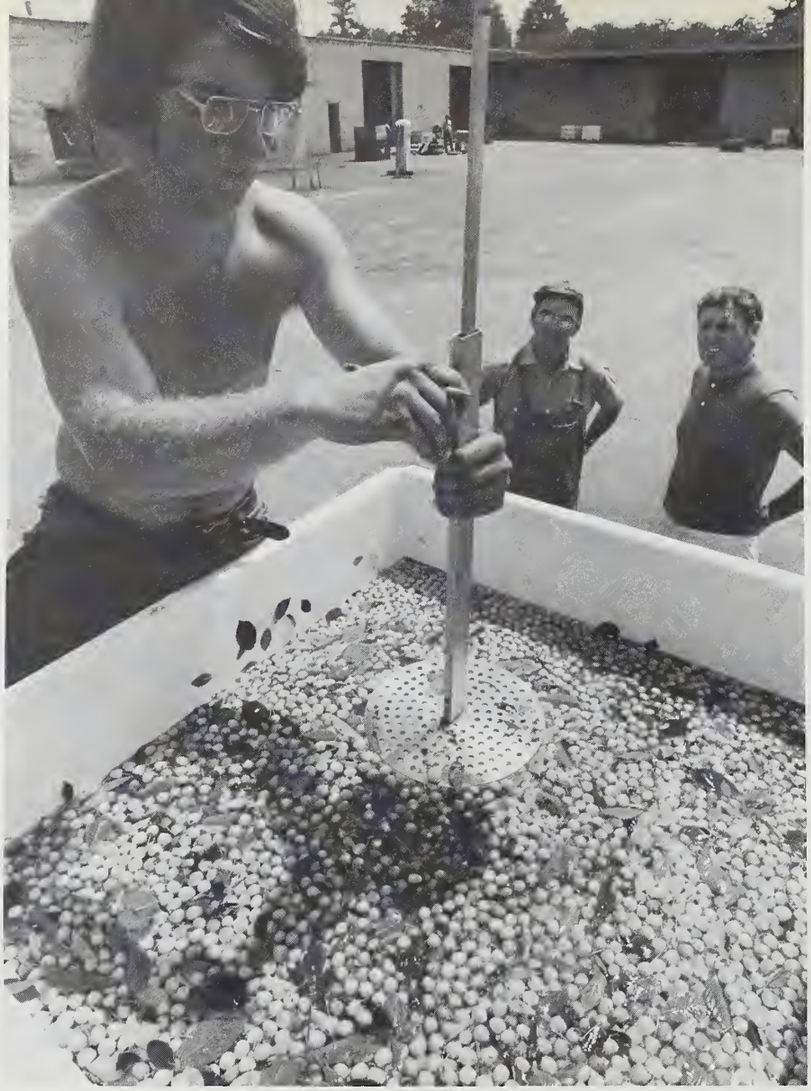
THE pickle industry seriously considered closing its processing plants about 7 years ago in Michigan, the No. 1 State in cucumber production. Labor for hand harvesting was unavailable, and mechanical harvesters were leaving half of the crop in the field.

Similarly, Michigan sweet cherry growers in 1969 were faced with the hard choice of going out of business because labor was not available or turning to mechanized harvesting methods that recovered only 68 to 80 percent of the crop.

Today, research has made mechanical harvesting feasible, and both industries are flourishing. About 92 percent of Michigan's cucumbers, 95 percent of its sweet cherries, 95 percent of its tart cherries, 93 percent of its juice grapes, and 90 percent of its cultivated blueberries are mechanically harvested.

In about 15 years, a team of engineers and scientists at East Lansing, Mich., developed fully integrated systems for mechanically handling each of these crops. Research progress and adoption of new ideas were speeded by the close cooperation of growers and processors. The pickle industry, for example, not only supported the research but appointed an advisory committee that met regularly with the researchers.

ARS is currently represented on the research team by agricultural engineers Jordan H. Levin, Bernard R. Tennes, and Dale E. Marshall and plant pathologist Clyde L. Burton. They work in close cooperation with agricultural engineers, horticulturists, and food scientists of the Michigan Agricultural Experiment Station, as well as with ARS biochemists at the Eastern Regional Research Center, Philadelphia, Pa.



Above: ARS engineer Jordan Levin and a grower look on as a processor's agent measures cherries by volume in a calibrated pallet tank. The method is as accurate as weighing and the cherries can remain in water, avoiding the risk of damage during handling (0874X1379–18A). ***Below left:*** *Prior to mechanical harvesting, cherry trees are sprayed with ethephon, a harmless chemical that loosens the cherries and reduces the shaking needed for the fruit to fall from the trees (0874X1383–4).* ***Below right:*** *Cherries ripen under a warm Michigan sun. Michigan leads the Nation in cherry production with an annual harvest of almost 232 million pounds (0874X1376–20).*

CHERRIES

The Michigan sweet cherry industry also shifted quickly to mechanization—from 15 to 95 percent of the crop in 3 years—after the research team solved two problems that had slowed adoption of machine harvesting for a decade. The problems: too many sweet cherries left unharvested by tree shakers, and loss of quality in handling maraschino cherries.

The research team demonstrated that 96 to 98 percent of the cherries could be detached, with a shorter shaking time and less bruising, after the trees were sprayed with ethephon, a chemical fruit loosener (AGR. RES., Nov. 1970, p. 5). Brining in the orchard instead of in the processing plant overcame the undesirable effects of bruising (AGR. RES., Oct. 1968, p. 12). An ARS-developed powder that can be mixed with water to make the brine in the orchard was used experimentally in 1972, and 6 million pounds of sweet cherries were brined by this method in 1973.

The research with sweet cherries was an extension of earlier work with tart cherries, one of the first fruits to be machine-harvested successfully. Original units were tractor-mounted, hydraulically activated shakers, plus collecting frames (AGR. RES., Jan. 1961, p. 8).

Other developments included substituting pallet tanks filled with water

for lug boxes to handle cherries in the orchard after picking, cooling pads, destemmers, electronic sorting, and volume buying.

CUCUMBERS

The research team made mechanical harvesting of cucumbers feasible by a combination of advances. Experiment station researchers redesigned the harvester for once-over operation instead of eight or nine successive harvestings and demonstrated that planting rates could be increased five-to-seven-fold. ARS and Michigan agricultural engineers took a close look at harvesting losses and at damage from handling in the field and at the processing plant.

From this research came a system for timing harvest for maximum yield, recommendations on harvester adjustment and operation, a technique for measuring susceptibility of cucumbers to damage, a system for density sorting cucumbers that should be processed immediately from those that can be held in brine, and changes in processing plants including foam cushioning, dumping in water, and reducing the number of times cucumbers were dropped.

As a result, mechanical harvesting of Michigan cucumbers increased from 20 to 85 percent of the crop in just 3 years.

Above: *University scientists are cooperating in research to develop improved cucumber varieties that are better suited for mechanical harvesting and handling during processing. In one phase of the research, technician Kaye Freeman adjusts a pickle slice under a probe that will determine the force necessary to penetrate it, an indication of the internal strength of the cucumber (0874X1418–17).* ***Below:*** *Vines laden with cucumbers are inspected prior to harvesting by Carl Ross, a field supervisor for a major Michigan processor, and ARS agricultural engineer Dale Marshall (right). Improved yields with mechanical harvesters depend on picking the crop when the number of ready-to-harvest cucumbers in the field is greatest (0874X1418–36).*

Top of page: *A horizontal-shake grape harvester paralleled by a tractor-drawn, 3½ ton, self-dumping, high lift moves through a Michigan grape vineyard. The self-dumping unit, which replaced the conventional 1-ton pallet boxes and forklifts, was developed by ARS scientists in conjunction with Michigan State University engineers (0874X1619–21).* ***Above:*** *Research technician Candy Counterman sorts trash (leaves, stems, and other foreign matter) from grapes using a prototype on-board conveyor (1074X1618–22A).*

GRAPES

The step-by-step shift from hand labor to machines is well illustrated in the handling of American-type, or Concord, grapes for juice in Michigan. In the 1950's they were hand-picked into beer lugs holding 25 to 40 pounds.

The lugs were stored under the vines until they could be hand-loaded on trucks. At the processing plant, unloading of trucks might be delayed 8 to 48 hours. The first research advance was a shift to palletized containers and forklift trucks. Next came machine harvesting, and then a complete bulk handling system (AGR. RES., Feb. 1973, p. 13).

Grapes now go directly from the harvester into self-unloading high lifts holding 3½ tons. The lifts move to row ends where the grapes are transferred to trucks that hold 8 to 12 tons and tilt for unloading at the plant.

An engineering efficiency analysis shows that the bulk handling saves more than $4,000 per machine. The quality of juice was judged equal or superior to that from conventionally harvested grapes in taste-panel tests involving industry quality control experts, an experienced panel at the Eastern Regional Research Center, and Michigan homemakers.

BLUEBERRIES

Mechanizing the harvest of cultivated blueberries came in two steps. First, the ARS-Michigan team developed a hand-held, electrically operated vibrator and a catching unit (AGR. RES., Oct. 1959, p. 7). Then came an over-the-row harvester which, with three men, does the work of 120 pickers who are difficult or impossible to hire (AGR. RES., Feb. 1964, p. 12).

Mr. Levin believes further improvements will be made in present harvesting and handling systems. For cucumbers, research is continuing on the density sorting technique, harvester modification, dirt removal, and in-plant han-

Above: *Inside the over-the-row blueberry harvester, beaters knock the berries onto conveyors on either side of the bushes. The interlocking plates prevent the fruit from falling to the ground (0874X1411–14).* ***Right:*** *As the inverted U-shaped harvester moves over the rows and the berries are detached, a fan separates the berries from the trash. The blueberries then move by conveyors into waiting lug-size containers which are stacked on the rear of the machine. At the end of each row the lugs are put on trucks for direct shipment to cleaning and grading facilities (0874X1411–10).*

dling. ARS is also working on improvements in cherry pitting and orchard brining, as well as ways to reduce cherry cracking losses, control of postharvest diseases by hot water treatment, and improved efficiency of machine harvesters. Studies with grapes are concentrating on eliminating trash during harvesting and reducing harvesting losses.

Farther in the future are refinements in mechanized systems to extend their use to fruits for the fresh market, where quality requirements are higher than for processed fruits.

A new harvesting system for apples is under development, and machine handling techniques for such crops as pears, peaches, plums, and strawberries are yet to be developed. Without mechanized harvesting, commercial production will decline because hand labor is unavailable, Mr. Levin predicts, noting that commercial strawberry acreage in Michigan has declined 60 percent in 13 years. □

Below: *Before the advent of the over-the-row blueberry harvester, ARS–MSU researchers developed an electrically operated hand vibrator to shake loose the berries. Eight times faster than hand harvesting, the vibrators are used extensively, especially by small growers unable to support the cost of over-the-row harvesters (0874X412–29A).*

for table and deli

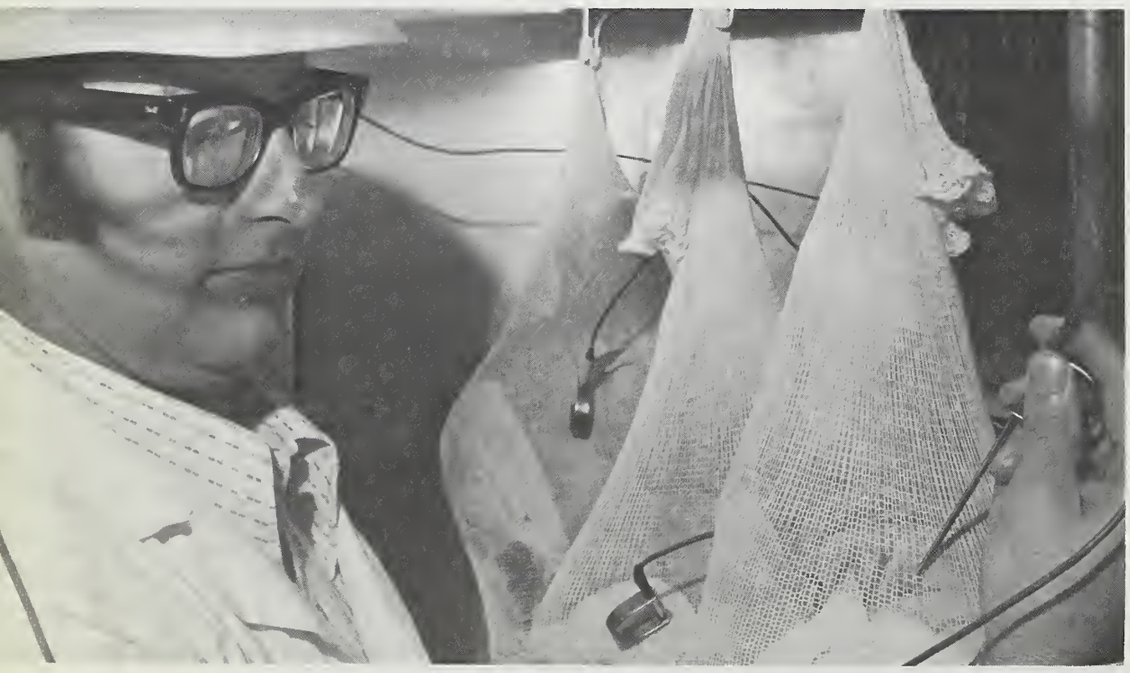
INCREASING HAM YIELDS

FROM the deli's ham-on-rye to the smell of that succulent country-style ham in the oven, ham is high on the culinary Hit Parade. Food technologists hope to make it even better and more plentiful by finding ways to improve lower grade pork and to increase final ham yields during processing.

Porcine stress syndrome, called PSS, is responsible for a prevalent type of low quality pork—pale, soft, exudative—known in the industry as PSE. Hot weather, poor ventilation, crowding, rough handling, and environmental conditions occurring during marketing all cause stress in the hog. Although PSS has a genetic origin as well, the environment is an obvious and immediate cause of both disease and frequent fatality. High body temperature, staggering gait, abnormal muscle acidity, and muscle tremors are observable symptoms.

At the Richard B. Russell Agricultural Research Center in Athens, Ga., characteristics of hams quality-graded on the pork cutting line in the meat packing plant prior to processing were studied by ARS scientists. The quality grades were (1) pale, soft, exudative (PSE) (2) normal (3) dark, firm, and dry (DFD). The pH of the ham muscles was determined on hams which had been "pumped" or injected with a standard commercial curing pickle. In all the tests, PSE hams had the most acidic muscles. The normal group was intermediate and the DFD group was the highest or most alkaline. The research indicated that pH is a factor which may be used in the selection of hams with different yield characteristics.

During two trials, hams were hung to drain for 5 hours, smoked and cooked overnight to an internal temperature of about 65° C., and then chilled for 24 hours at 2° to 4° C. However, in the second of the trials the hams were held overnight in a brine solution before smoking and cooking. In both trials and within each quality group, shrinkage was highest during the smoking and cooking stage of processing. The PSE quality group lost the greatest amount of weight during this stage.



Dr. Davis places a temperature probe in a ham to insure temperature control during smoking and cooking tests on the hams. The tests determine weight losses of the hams during commercial processing (0974X1547–1A).

The softness of the PSE (pale, soft, exudative) ham (left) is evidenced by the flattened, oval shape of the muscles. The graduated cylinders show the amount of meat juice lost in a 24-hour period from fresh PSE, normal, and DFD (dark, firm, dry) ham groups. PSE hams lose up to one and a half times more weight than normal and DFD hams during commercial curing processes (0974X1458–2).

"We concluded that the ability of muscle tissue to bind and retain meat juices during smoking and cooking is critical," said food technologist Carl E. Davis. "PSE hams lose up to one and a half times more weight than normal or DFD hams." The final yield of the PSE hams was 2.76 and 5.54 percentage points less than yields of normal and DFD groups, respectively.

Researchers improved the final yield in PSE hams by injecting more curing pickle within regulatory limits, to compensate for the additional losses that occurred during smoking and chilling. "Also, in trial 2 the additional holding time in cure before the hams were smoked and cooked increased the water-holding capacity of the muscle," added Mr. Davis.

During oven cooking of center-cut ham slices, the quality of the fresh ham muscle affected the amount of cooked-out juices. The PSE quality had the greatest amount; normal, an intermediate amount; and the DFD the least amount of fluid loss.

With pale, soft, exudative ham, soft does not mean tender. PSE cooked ham slices had the highest shear values (a measure of ease of cutting), which indicated less tender meat.

The study showed that processing hams according to a uniform curing, smoking, cooking, and chilling cycle without first evaluating the fresh muscle quality would result in a wide and wasteful variation of final ham yield.

ARS food technologist William E. Townsend, microbiologist Arthur J. Mercuri, and University of Georgia animal scientist Harry C. McCampbell collaborated on the quality trials with Dr. Davis. □

Improving on the Pharaohs

Put to use in the granaries of the Pharaohs, inert dusts may yet have their day in the modern context of economical, safe control of stored grain insects. Nontoxic to mammals, inert dusts cause dehydration, resulting in high insect kill, either through abrasion or absorption, or both.

As an economical alternative to such sophisticated and expensive controls as radio frequency kills and radiation sterilization, inert dusts have limitations which currently prevent their use in U.S. granaries. Dr. Lyman S. Henderson, ARS-cooperating scientist for recent Yugoslav research on inert dusts, says these limiting factors are the workers' environment, extra wear on grain handling machinery, and lowered grain grade. "However," he said, "knowledge of how inert dusts effect control may allow us to overcome or lessen these problems. For example, the Yugoslavs found that inert dusts worked very effectively in water suspensions; using a spray could lessen dust clouds that affect working conditions. Water suspensions might seem contradictory to the requirements of low humidity for insect control, but the Yugoslav experiments have shown that evaporation of water from these suspensions occurs rapidly after they are applied to the grain."

Among the promising dusts the Yugoslavs studied were: natural minerals—the silicates, such as bentonite and diatomaceous earth; synthetic dusts, such as silica aerogels; and saturated muds. Diatomaceous earth is an inert powder composed of finely ground fossils of microorganisms called diatoms. This fossil material is mined in many parts of the world.

The two most successfully used saturated muds—VK-chalk and Zupanja 62—were activated by heat treatment. Activation controls the magnitude of the spaces between the dust particles and contributes to the efficiency of insecticidal action.

The Yugoslavs found that the activity of the dusts depended on their specific properties and not on their volume. In some tests the scientists established an efficient minimal dosage rate of .05 percent of grain weight for the siliceous aerogels and .2 percent for activated-saturated muds and diatomaceous earth.

The researchers also found that some of the inert dusts were highly specific, bentonite against the bean weevil, for example. Their experiments also showed that VK-chalk and Zupanja 62 were more effective than the silica aerogels against the granary weevil, *Sitophilus granarius*.

Investigating pathogens, the researchers isolated a protozoan, *Mattesia pavolny*, that causes high mortality in Indian meal moths. More test data on the safety of this type of biological control are needed. A known advantage is that it is self-generating within the insect, therefore indefinitely residual.

The research was conducted under the provisions of P.L. 480 at the Institute for Plant Protection, University of Zagreb. □

Breeding 'perpetual' hybrids

RADIATION tests with pearl millet have produced two mutant plants that present the possibility for a revolution in hybrid seed production.

Pearl millet is a major livestock feed crop in the United States and a human food crop in many parts of Asia, Africa, and Europe. ARS plant geneticist Wayne W. Hanna and his colleagues at the Coastal Plain Experiment Station, Tifton, Ga. have been testing the response of millet to radiation in hopes of improving the crop as a forage and food source.

Several mutations were byproducts of those tests, but two in particular show special promise. One is a genetic female sterile and the other a facultative apomict. The two have started the scientists down the road toward possibilites that are, at the very least, fascinating. Here is the story.

In general, a grass may cross with any other plant of its species or with itself. The goal in breeding work is to cross specfic plants with only certain ones serving as the male and female parents; therefore, these plants need to be pollinated by hand or isolated to assure the desired cross.

In some crops, such as millet, plant breeders have been able to develop male steriles which serve as female parents to produce hybrid seed when pollinated with the intended male parent plants.

The male parent can still self pollinate and produce seeds therefore, the male and female parents must be separated in the seed production field so the seeds do not get mixed.

Now a female sterile gene has been isolated in pearl millet. With proper genetic manipulation of the female sterile gene, it would be possible to combine seed of the male parent (female sterile) and female parent (cytoplasmic male sterile) and plant the two parents together in the seed producing field. All plants would be harvested. The very small percentage of self-pollinated seed produced would not affect yield of pearl millet.

This much alone holds promise for simplifying seed production and conserving land area. But that is just the beginning.

Pearl millet is one of several plants known to exhibit facultative apomixis, that is, it produces seeds in two ways: sexually, through fertilization of an egg from the female by the sperm from the male, or apomictically, whereby the embryo develops from vegetative cells without fertilization of an egg.

Plants from the apomictic seeds are genetically identical to the parent. If a high quality hybrid were produced that was apomictic, seeds from the first generation could be saved to produce a second generation that was identical to the parent—with no loss in hybrid vigor. The same would be true for the future generations.

Usually, sexually produced hybrids have to be produced each year since advantages of hybridization decrease with each succeeding generation.

In the ARS investigations, Dr. Hanna reports that only 25 percent of the seeds of a pearl millet mutant were produced by apomixis. To get the full advantage in hybrid production, obligate (100 percent) apomixis would be desired. Here the female sterile trait enters the picture.

With appropriate crosses, the female sterile is being used to eliminate the sexual tissue in facultative apomictic plants. Hopefully, this will encourage the vegetative cells to produce an embryo, thus enhancing apomixis. Appropriate genetic manipulation would bring this to the obligate point.

Apomixis is probably present in most species or at least in a related or wild species. Special efforts should be made to discover this valuable plant breeding tool, Dr. Hanna said.

Being able to grow "perpetual hybrids" like this would have great potential, especially for the developing nations of the world that desperately need the additional yield that high quality hybrids could provide. At present the cost of buying new hybrid seed each year may be prohibitive or simply unacceptable. Using apomictic hybrids, farmers could save seed from each crop to plant the next season without losing hybrid vigor.

Similar advantages are also possible for the seed industry. Each year, seed producers must begin with the original parent lines and produce the hybrids for a new seed crop. Eliminating this step would save money on seed production which could be passed on to farmers and consumers, with the additional potential of increasing total food supplies at the same time. Apomixis would lessen the need for highly trained production people and would increase the opportunity for breeders to use superior gene combinations in hybrids.

Admittedly, the perpetual hybrid is far from being a reality, but it is a lot more than fiction. Based on the evidence and what scientists already know about plant genetics, the theoretic possibilities are clearly evident. A long process of research will be needed, but the promise of more efficient food production for the world's population makes the effort worth taking. □

Shipping potatoes

FINDING ways to protect potatoes from costly quality deterioration in marketing channels represents a major challenge, as more potatoes are produced than any other vegetable in the United States. Losses averaged about 5 percent over a 4-year period for Maine's Katahdin potatoes in New York City markets alone. Nationally, these losses add up to a multimillion dollar problem.

In a study aimed at reducing these losses, ARS horticulturist Donald E. Hudson compared three systems of handling and loading commercial shipments of potatoes. Savings of about $47 for each truckload resulted from experimental methods tested for shipments between Mars Hill, Me., and a wholesale market at Philadelphia, Pa.

The experimental system employed corrugated boxes and polybags at a cost of $304.80. Damage and grade losses to potatoes so packed was zero.

Materials used in the conventional shipment cost $184.68. Added to this cost was $167.20 to cover 4.2 percent damage and downgrading of the potatoes. Thus, the total costs came to $351.88, or $47.08 more than the experimental shipment. The third, or modified-conventional system cost $184.68, and resulted in 0.2 percent damage and downgrading of the potatoes.

The differences in overall costs of the experimental and the two comparison shipments might be even larger if handling time is also considered. With an inexperienced crew the experimental shipments were loaded in 405 minutes while the conventional system in which the crews were experienced, took 433 minutes and the modified-conventional system took 458 minutes.

In the first of the three handling systems tested, the shipper packed potatoes in 10-pound consumer bags. These were placed in experimental corrugated boxes, each holding five bags. Workers loaded the boxes on 48 x 40-inch pallets for shipment in 40,000-pound truckloads.

For comparison, Dr. Hudson studied a second lot of potatoes shipped with the most prevalent commercial materials and procedures. The shipper placed the potatoes in 10-pound polyethylene bags which, in turn, were packed in paper master containers called balers, each holding five 10-pound bags. Workers loaded the balers on the floor of the truck, using conventional stacking patterns to evenly distribute the load and provide adequate ventilation.

The third comparison lot of potatoes was like the second lot except that the balers were loaded on pallets, placed in a pattern of seven rows across with a tier height of six balers.

The Maine Life Science and Agriculture Experiment Station at Orono cooperated in this study.

Antibodies in joint fluids

ANTIBODIES—a source of resistance to disease—may be transferred to joint fluids of newborn calves within 4 to 8 hours after feeding colostrum.

Transfer of maternal antibodies to blood serum of newborn animals by feeding colostrum, the first milk produced after giving birth, is well known. Knowledge that antibodies are also quickly transferred to joint fluids may be important in understanding and treating diseases that produce an arthritic condition in joints.

In a study at the National Animal Disease Center, Ames, Iowa, ARS biochemist Stanley S. Stone and veterinary medical officer Billy L. Deyoe used the bacterium *Brucella abortus* as the test organism in monitoring transfer of antibodies. *B. abortus,* which produces brucellosis in cattle, was chosen because the antibody is well known and readily detected by laboratory procedures.

Calves from dams that were brucellosis-infected had no *Brucella* antibody in their serum or joint fluid collected before they suckled the first time. Agglutination tests, however, showed that antibodies appeared in blood serum within 2 hours after feeding and in joint fluids within 4 to 8 hours.

The researchers say that transfer of passively acquired colostral antibody to joint fluids could serve as an immunologic defense mechanism.

Processing peaches

A NEW METHOD that would allow a processor to store peaches in bulk before processing is under development. It will allow processors to extend their plant operations by 20 weeks or more, thereby enhancing efficiency. Currently, processing runs last only 6 to 8 weeks.

Experiments showed that it is possible to preserve cling peach halves in a sulfur dioxide (SO_2) solution for several months at room temperature. The peaches were kept in tightly closed steel drums with a plastic inner coating, or in 400-gallon sealed tanks.

Some softening of fruit occurred but this can be controlled by adding calcium. Adding sugar to the SO_2 solution improves texture slightly but has the disadvantage of making yeast control more difficult.

An extraction with hot water successfully removes the SO_2 from the peach halves before canning. The extraction is quick and causes no harm to color or texture. However, along with the SO_2 go both the sugar and acid. These are replaced before canning.

The process was developed at the Western Regional Research Center, Berkeley, Calif., by research chemists James D. Ponting, Rogernald Jackson, and David W. Sanschuck, and agricultural engineer Charles C. Huxsoll.

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Ineffective decontamination

MATS or boot tubs are often ineffective in preventing the spread of micro-organisms on footwear in infectious disease laboratories and animal housing facilities.

In fact, mats or tubs not given meticulous care may present a greater hazard than if none are used. Microbiologists Donald T. Braymen and Joseph R. Songer and safety officer James F. Sullivan at the National Animal Disease Center, Ames, Iowa, found that decontamination units can add to the number of micro-organisms already on footwear.

The units are placed at entrances to prevent introduction of contaminants or at exits to prevent their escape. The mat type for shoe sole decontamination is kept soaked with a disinfectant solution. The boot tub, often used in animal holding areas, is designed for immersion of footwear in disinfectant solution.

Organic matter removed from footwear accumulates in mats or tubs with use, researchers say, neutralizing of binding active ingredients or disinfectants, and often serving as a medium for their growth. The researchers added 2.5 percent organic matter and a test organism to disinfectant solution in a tub, then dipped and scrubbed a sterile boot in the solution. Each of three organisms used was recovered from both the solution and boot surface up to 48 hours later.

Only 5-percent phenol and 10-percent formalin, of 11 disinfectants tested, were totally effective against three test organisms in a mat decontamination unit. Many disinfectants allowed bacteria to survive on the mat, even after 24 hours.

Concentrated apple slices

A lightweight see-through container made from plastic can serve as a storage package for concentrated apple slices.

This package of apples, which is pasteurized, makes an ideal product for busy homemakers. All that is necessary to prepare apple slices for a pie is to open the package, add an equal amount of water, let sit overnight, and use the next morning. For quick use, one can bring the slices to a boil in water, cool them and they are ready to use as pie filling. Other uses for concentrated apples direct from the package include cake and strudel.

The compact package is easily stored in the refrigerator and keeps for 4 months or longer. The package is ideal for processing because it is flat. Heating for pasteurization takes only mintues; minimum heat results in improved product color and texture.

Chemical engineer, Melvin E. Lazar, Western Regional Research Center, Berkeley, Calif., says "The package is easily opened and disposed of, see-through, lightweight and compact, doesn't react with package contents like metal cans, and will not shatter like glass containers."

The apple slices, reduced approximately one-half in weight and volume by a process previously developed at the Center, retain practically all of their original color and taste.

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

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